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SHEEP SCAB.

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HISTORY AND CHARACTERISTICS.

Scabies in sheep, commonly known as sheep scab, is one of the oldest known, most contagious, and most injurious diseases affecting sheep. Its history dates back to the earliest ages of civilization. It is a highly contagious skin disease, easily transmitted from one sheep to another, and spreads very rapidly after being introduced into a flock. It is caused by a small animal parasite, commonly known as a "mite," which lives on the skin. Although the disease is not hereditary, it is possible for a new-born lamb to become infected from a diseased mother shortly after birth, and this fact has led some sheep owners to think it is hereditary. Besides common sheep scab there are several other varieties of scab affecting sheep, each caused by a distinct species of mite, but they are of comparatively little importance and will not be considered in this bulletin.

When allowed to spread, sheep scab causes great financial loss to the industry. These losses are caused by (1) a decrease in the quantity of wool produced, (2) loss in weight and general condition from irritation and other effects of the disease which render the animals unthrifty, and (3) the death of large numbers of infected sheep.

NOTE.—This bulletin is intended for the information of sheep raisers and live-stock sanitary officers concerned in the prevention, cure, or eradication of sheep scab. It supersedes Farmers' Bulletin 159.

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While the disease is highly contagious, insidious in its nature, and severe in its effects, it yields readily to proper treatment and is easily cured. A sheep owner should never allow scab to remain in his flock, as it can be easily eradicated by proper dipping.

Common scab was formerly the greatest drawback to the sheep industry of the United States, but during the past decade great progress has been made in its eradication. The system of grazing sheep on the open ranges of the western part of the United States was such that the flockmasters had great difficulty in keeping the flocks free from scab. The sheep were very frequently exposed to the disease by infectious ranges and trails, "picking up strays" from infected flocks, and in many other ways. It became desirable for the Department of Agriculture to extend aid to the industry by controlling the interstate movement of sheep to prevent the carrying of the infection from one State to another. Arrangements for cooperative work with the live-stock sanitary authorities of the various States concerned were made by the Bureau of Animal Industry with the object in view of completely eradicating the disease. This work has been in progress for about 10 years, and during that time the disease has been reduced to a minimum over the entire area and nearly all the formerly affected States have been released from quarantine. The disease has been so nearly eradicated that at present the economic losses from this cause are practically nil. In view of the highly contagious nature of the disease, however, it is very important that the work of eradication be pushed to completion in order to prevent the disease from again becoming prevalent.

With our present knowledge of and experience in sheep-scab eradication work, it is comparatively easy to reduce the infection to a point where it ceases to cause economic loss, but the complete eradication of the parasite over such vast areas is a problem requiring patience and diligence. Where the eradication work is supervised by a well-organized force of trained field men, the percentage of infected flocks can be reduced very rapidly until it reaches a fraction of 1 per cent; but to reduce that fraction to zero requires very careful and systematic work, with the full cooperation of the sheep owners. As soon as the disease is reduced to a point where the economic loss is little or nothing, many sheep owners lose sight of the importance of continuing systematic efforts for complete eradication. It is necessary, however, for the protection of the sheep industry that the efforts be continued until the pest is completely eradicated.

Since the quarantine has been removed and compulsory dipping discontinued the sheep owners in some communities have allowed their dipping vats to go to ruin through lack of use and care. All

vats should be kept in repair, and for several years to come each sheep owner will probably find it wise to dip his sheep at least once a year as a precautionary measure.

THE PARASITE WHICH CAUSES SHEEP SCAB.

The mites which cause common sheep scab are small insectlike parasites known technically as *Psoroptes communis ovis* or *Psoroptes ovis*, the male measuring when fully grown only about one-fiftieth and the female one-fortieth of an inch in length. They may be seen with the naked eye, particularly if they are placed on a dark background. They occur on any portion of the body covered by wool, but are most common where the wool is thickest; they are the sole cause of the disease. (See figs. 1 and 2.) Their destruction is followed by recovery, whereas any treatment which does not destroy them fails to cure scab.

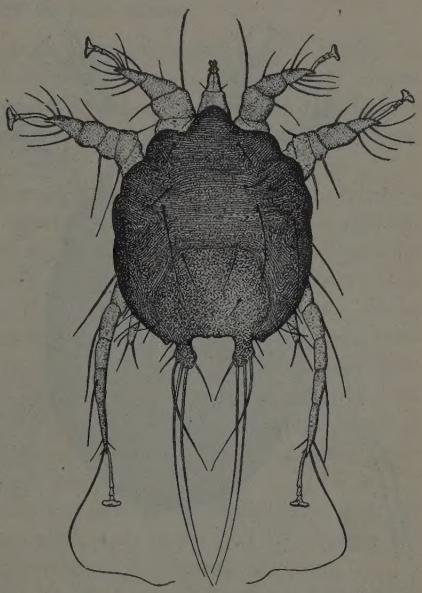

FIG. 1.—Sheep-scab mite (*Psoroptes ovis*). Male. Dorsal view, greatly enlarged. (After Salmon and Stiles, 1898.)

LIFE HISTORY OF THE SCAB MITE.

The various stages in the life history of the scab mite are all passed on the body of the sheep. After the mating of the sexes the females deposit their eggs in clumps on the skin at the base of the wool fibers. Each female may deposit at least as many as 15 eggs, which hatch after 3 or 4 days' incubation; the young mites grow to maturity in 7 or 8 days and in 3 or 4 days more mate and deposit their eggs. The females apparently live but a short time after they have laid their eggs.

According to the figures above, which are those given by Gerlach, the entire life cycle is completed in 12 to 15 days. Other observers state that the period of incubation of the eggs may be as long as 10 days, but this is probably exceptional, and 7 days may be assumed to be the usual maximum limit of incubation. Assuming that each female has 15 offspring and taking 15 days as the period required for each brood of eggs to hatch and the young mites to develop

to maturity and deposit another brood of eggs, Gerlach has estimated that the sixth generation from one pair of mites, which may appear in 90 days, may consist of as many as a million and a half individuals. Another 15 days may bring the number up to 15,000,000 and 15 days more to 150,000,000. This calculation, though theoretical and only approximate, gives an idea of the rapidity with which these parasites multiply and shows that a few mites gaining a foothold on one or two sheep may in a short time have descendants enough to infest heavily the entire flock. The importance of prompt treatment when scab is discovered in a flock, or if sheep have been exposed to infection, is evident.

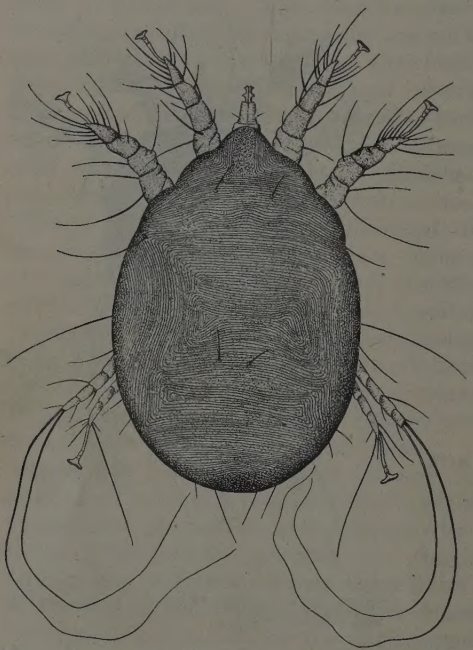

FIG. 2.—Sheep-scab mite (*Psoroptes ovis*). Female. Dorsal view, greatly enlarged. (After Salmon and Stiles, 1898.)

Some of the points in the life history of the scab mite, as outlined above, have a certain bearing on the question of the time which should elapse in the treatment of sheep scab between the first and second dippings. It has been found that a single dipping usually fails to free a flock from scab, the apparent reason being either that all the females in the course of depositing eggs at which time they appear especially tenacious of life) or all the eggs already deposited have not been destroyed by the dipping; consequently, after the eggs which may have escaped the first dipping have had an opportunity to complete their incubation, it is essential to dip the sheep again. It is also essential that the second dipping take place before any mites which may hatch out after the first dipping have had time to become mature and deposit more eggs. As the eggs on the body of the host usually require 4 days' incubation, sometimes a week, and probably never more than 10 days, and as 10 to 12 days are necessary for

the young mites after hatching to grow to maturity, mate, and deposit their eggs, it would appear that the best time for the second dipping is about 10 days after the first, as all the eggs will have hatched, while practically none of the new generation of mites will have developed sufficiently to deposit eggs. Practical experience has shown that the second dipping may be delayed until the fourteenth day without unfavorably affecting the results of the treatment, but wherever possible it is preferable to follow the 10-day rule.

VITALITY OF SCAB MITES.

The species of mite which causes common sheep scab is unable to propagate itself except on the bodies of sheep, its natural host. Mites of this species, however, when removed from the host, are able to live for some time, the period of survival varying under different conditions.

From a practical point of view and because of the spread of infection from diseased to healthy sheep through the medium of stables, pastures, etc., and the fact that the mites or their eggs, scattered by diseased sheep, may survive until picked up by healthy sheep, this question of the length of time that mites or their eggs may retain their vitality when away from the host is obviously an important one. Various data which have been collected relative to this subject show that mites removed from the body will commonly live from 2 to 3 weeks, and cases have been recorded of their survival for as long as 2 months. It appears certain that under natural conditions they sometimes live much longer.

A dry atmosphere is very unfavorable to their existence away from their host. Other things being equal, scab mites will live longer off the body in a cool, moist atmosphere than in a warm, dry one.

Owing to varying conditions which may affect the longevity of mites and the vitality of their eggs when away from their natural host, it is impossible to make definite statements as to the length of time infection of pastures and buildings may persist after sheep have been removed from them. It is fairly safe to assume, however, that a month or two will suffice to free open pasture from infection, but that buildings, pens, bed grounds, etc., will not be safe even after a year or more; consequently these latter places, when they have been occupied by infested sheep, should be abandoned, destroyed by burning, or thoroughly cleaned and disinfected before they are used for clean sheep.

SYMPTOMS OF SCAB.

When the scab mite finds lodgment on a sheep it pricks the tender skin to obtain food, and in so doing probably introduces a poisonous saliva into the wound. A slight inflammation is caused, made man-

ifest by a reddening of the skin. This stage of the disease is rarely if ever detected by casual observation. (See fig. 3.) As the mites multiply, large numbers of small wounds are made in the skin and are followed by intense itching, with formation of papules, inflammation, and exudation of serum. The serum, which oozes to the surface, becomes mixed with the natural excretions and particles of dirt, and more or less infested with microorganisms. This mass soon hardens into crusts or scabs in the wool; these in the early stages are of a yellowish color, but as the disease advances and the scabs thicken they become dark from blood stains, dirt, and other causes. When the disease begins only a small pimple can be seen, but as the mites

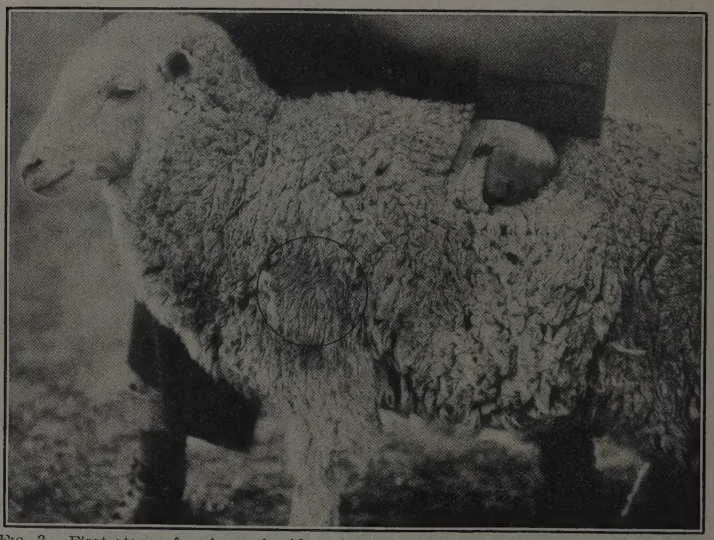

FIG. 3.—First stage of scab on shoulder, showing natural position of wool disturbed by biting and scratching.

multiply they seek the healthier parts around the edges of the diseased area, and thus the lesion or scab is continuously enlarged. The areas of the skin affected become hardened and thickened. This is readily detected by pinching up a portion and comparing it with the surrounding healthy skin. Other conditions resembling scab rarely if ever cause this characteristic, uniform thickening of the skin. When the affected skin is pinched or handled, the sheep as a rule turns its head toward the lesion, thrusts out the tongue, licks the lips, and champs the jaws.

The intense itching causes the sheep to become restless. This irritation is particularly noticeable after the animals have been

driven, as itching is more intense when they are heated. They bite and scratch themselves and rub against any available object, including other members of the flock. The natural position of the wool is disturbed by these efforts to obtain relief, and as more or less wool is pulled out, the fleece assumes the condition known as "broken." At first the wool on the affected parts, if within reach of the mouth, is seen to have been chewed and some of it pulled out. The wool on affected parts not within reach of the mouth has a discolored, worn, or ragged appearance, caused by scratching with the hind feet or

FIG. 4.—First break in fleece, early stages of scab, lesions about the size of a pea.

rubbing against other objects. At this stage the marks of the mouth or feet on the fleece or the disturbed position of the wool may be the only visible symptoms, unless close examination is made of each individual sheep. (See fig. 5.) As the disease advances increasingly large areas become entirely denuded of wool. Scabs fall and are replaced by thicker and more adherent crusts. The skin finally becomes more or less bare, tumefied, is greatly thickened, and may crack and bleed. Unless properly treated many of the animals will die.

DETECTING SCAB IN THE EARLY STAGES.

The most certain diagnosis consists in demonstrating the parasite (*Psoroptes communis ovis*) which alone causes the disease. To obtain specimens of live mites one of two methods is usually employed; first, lifting the mite from the surface of the skin with the point of a knife blade, and second, taking scrapings of wool and epidermis containing the mites and isolating the parasites from such scrapings. To obtain mites with a knife blade, good light is necessary. The wool around the affected area is suddenly parted with the forefinger and thumb, and by the aid of a magnifying glass or even with the naked eye the mites can often be seen moving rapidly away

FIG. 5.—Characteristic scab lesion in early stages of the disease.

from the light. When they are thus found they can often be picked up on the end of a knife blade.

When scrapings are taken the outer edges of the infected areas should be scraped with a blunt-edged knife. The mass of scrapings is transferred to a smooth, black surface such as the brim of a black hat or a piece of black paper. To make the mites active the temperature should be approximately the temperature of the body. Spreading the scrapings in the bright, warm sun or near artificial heat will usually cause the mites to become active, and they can be seen as minute gray moving bodies against the dark background. They are quite plainly visible under a low-power hand lens.

When the mites are producing active irritation the surface of the skin in the immediate vicinity of the lesion is greasy and appears bright and glistening or white and glossy. Under such conditions

the mites are usually present in large numbers and are easily found. On the other hand, if the lesion is dull and dry in appearance it indicates that the mites are inactive at that point and that they will be difficult to find. Usually the latter condition is found in the center of a patch of scab of comparatively long standing or where the mites have been destroyed or rendered dormant. The white, glossy appearance is seen in cases of recent infestation or on the outer edges of old lesions. It is often difficult to find mites during cold, stormy weather, as they apparently leave the infested area, where the wool is light, and seek shelter where it is heavier.

Any condition which causes the sheep to bite and scratch should be investigated at once and the cause definitely learned. Scab on certain parts of the sheep's body may be overlooked. It is usually found on the back or sides, but may start on any part of the body. Lambs are sometimes infected around the head between the horns and ears, and as these parts are frequently covered with dirt the lesions may not be noticed unless close examination is made. Scab mites are sometimes found in the ear and in the groove beneath the eye, which may explain some cases of fresh outbreaks after treatment, the mites in these places surviving imperfect dipping. On wrinkled breeds, and especially on the bucks of these breeds, scab may be so well concealed in the wrinkles as to render its detection difficult. The breasts and bellies of suspected bucks of all breeds should be closely examined, as these parts are frequently affected. In some cases a considerable area of scab may be present, especially on the back of the sheep, without causing a break in the fleece. In these cases, most often found in tight-wool sheep, the wool will be "raised" from the skin but is held so firmly by the surrounding wool that it may escape detection. Bucks are not so sensitive to the effects of scab as other sheep; consequently they may have scab a long time without showing any breaks in the fleece. In some cases they do not bite or rub the affected parts enough to cause dislodgment of the wool. (See fig. 7.)

Well-advanced cases of hard scab are usually easy to diagnose, but the disease should never be allowed to reach this stage, as it entails heavy loss to the owner and the entire premises may become infectious. The experienced sheep grower realizes that a case of common scab, if neglected and allowed to spread, will materially reduce the profits and often place the balance on the wrong side of the ledger.

CONDITIONS WHICH MAY BE MISTAKEN FOR SCAB.

Any parasite or condition which causes itching and thus leads the sheep to scratch themselves may temporarily be mistaken for scab, but if it is remembered that scab is caused only by scab mites, and

that unless they are present there can be no scab, the diagnosis is rendered more simple.

Common sheep scab may be differentiated from conditions caused by other parasites, such as sheep ticks, common ticks, and lice, by finding the parasite and by the nature of the lesion. If the itching is caused by ticks an examination will reveal the ticks. (See fig. 8.) They are much larger than the scab mites and are of a dark-brown color. If lice cause the sheep to scratch they can be found on examination, and as they are much larger than a scab mite they are

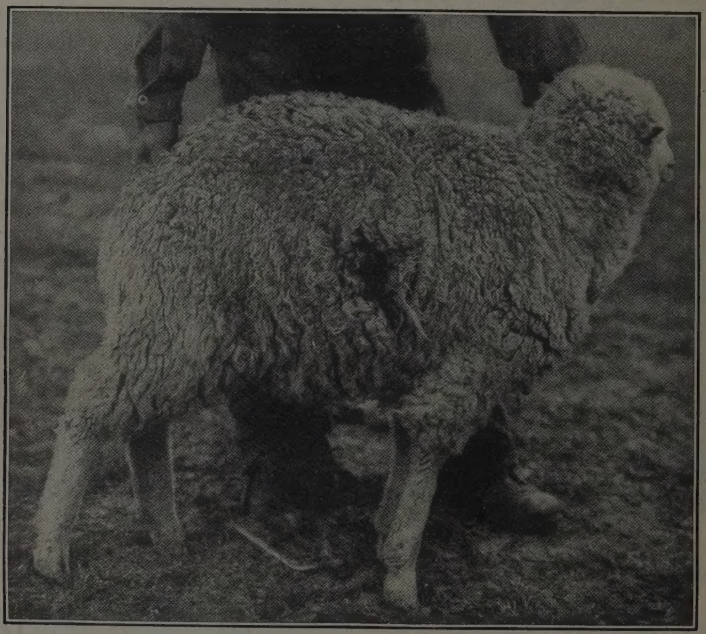

FIG. 6.—A case of scab more advanced than that in figure 5, showing area denuded of wool.

easily identified. Ticks and lice do not, as a rule, produce pronounced local lesions. They move more or less from place to place on the skin, so that scratching and biting is not repeated persistently in one place as in the case of scab. It should be remembered, however, that ticks or lice may be present on scabby sheep and that their presence in itself is not enough to warrant the exclusion of scab as a possibility in the diagnosis.

Bearded seeds of grass and weeds, thorns and spines from cacti and various other plants, often become lodged in the fleece and prick

the skin, setting up an irritation which causes the animal to bite and scratch. In this way wool is pulled out in small tags and the fleece often presents a ragged or broken appearance. The bearded seeds or thorns sometimes penetrate the skin, causing an abscess. On close examination the causative agent can usually be found and removed.

Eczema, wildfire, summer sores, inflammation of the sebaceous glands, rain rot, shear cuts, sunburn, and the effects of alkali dust on areas denuded of wool may be mistaken for scab by those who are inexperienced.

FIG. 7.—Scabby buck with entire hind quarters and flank affected. (The discolored area is due to dip stain from hand dressing.)

Eczema is an inflammatory condition of the skin and is usually accompanied with itching and the formation of crusts and in some cases scabs. It is differentiated from scab by the fact that it does not cause the characteristic thickening of the skin found in common scab and the mite is not present.

Wildfire, so called, affects sheep mainly in the Northwestern States. It causes the sheep to bite and scratch, and the pulling of the wool causes breaks in the fleece. Upon examination of the infected sheep the skin is found to be red and inflamed but is soft to the touch. It is not hardened and thickened, as in scab.

A condition commonly known as summer sores exists among sheep in some localities. It appears as an irritating sore on the skin. The sheep bite and scratch the affected parts until the wool is pulled out and the skin becomes raw and bleeding. It is differentiated from scab by the absence of the scab mite, the character of the lesion, and the fact that the skin is not thickened in the characteristic manner.

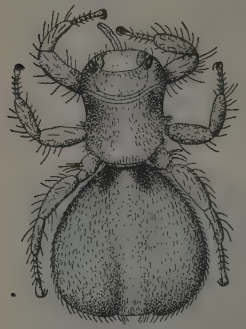

FIG. 8.—Sheep tick (*Melophagus ovinus*). Male. Dorsal view, enlarged. (From Curtice, 1890.)

Inflammation of the sebaceous glands may be mistaken for scab. There is severe itching, the skin is red and sensitive, and there is an excretion of a strong-smelling, yellowish, viscid yolk. The skin does not have the characteristic appearance of scab and the mite is not present.

In rain rot, a condition occurring in rainy weather, an eruption may appear on the skin which might be mistaken for scab. There is, however, no parasite present, itching is absent, and the trouble disappears when dry weather comes.

Shear cuts, sunburn, and the effects of alkali on the skin are conditions found in sheep after shearing. They are easily differentiated from common scab by the character of the lesions and the absence of the scab mites.

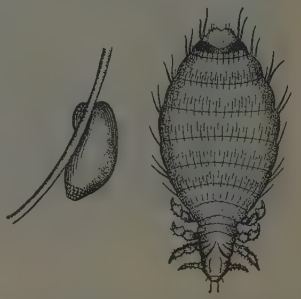

FIG. 9.—Sheep foot louse (*Hæmatopinus pedalis*). Adult female and egg, enlarged. (From Osborn, 1896.)

CONTAGIOUSNESS OF SCAB.

Sheep scab is exceedingly contagious and is transmitted by direct contact with animals or objects that are carriers of the mites. Although unable to propagate except on sheep, the mites may be harbored temporarily by animals other than sheep and may live on goats for a long period. Consequently, in the eradication of the disease, goats belonging to a flock of scabby sheep should be handled and treated in the same way as the latter. Sheep scab spreads through a flock very rapidly, once it is introduced. The contagion may be direct, by contact of one sheep with another, or indirect, from tags of wool, fence posts against

which infected sheep have rubbed, or from places where they have been. A flock of scabby sheep will infect the roads, trails, sheds, yards, bed grounds, pactures, ranges, and the ground around the watering places. It is therefore important that the flock receive proper treatment as soon as the disease appears, before the infection becomes scattered over the premises.

The transmission of the disease to a flock is not limited to any one season of the year, although during the hot summer months few cases of recent infestation are noticed in the range sections. Scab often remains dormant during dry summer months and assumes the appearance of having been cured, but usually becomes evident again with the advent of cold, rainy weather.

FIG. 10. — Sheep louse (*Trichodectes sphærocephalus*). Adult female, enlarged. (After G. Neumann, 1892.)

Symptoms of scab may develop within a week after healthy sheep have been exposed to it. The usual practice is to consider that the disease may develop at any time within 30 days after exposure, although, under certain conditions, the development may be retarded even longer. The disease develops more rapidly in the fine-wool breeds, such as the Merino and Rambouillet, than in the loose-wool breeds having an open fleece, and the fine-wool sheep also succumb more rapidly to an attack, so that treatment must be very carefully applied if the results are to be successful. The fleece of the fine-wool sheep contains much grease or yolk, which in a measure hinders the penetration of the dip.

The effect of sunlight on the scab mite is apparently an important factor, since the disease develops most rapidly and is seemingly most severe in its effects on the fine-wool sheep, and is diminished in its effects and retarded in its development in a direct ratio as the fleece becomes more open. The Navajo Indian sheep, which have very coarse, open fleeces, resembling somewhat that of a goat, rarely if ever are affected with hard scab. While the infection will remain in a flock of such sheep indefinitely if not treated, the lesions seldom become extensive. In the semiarid sheep-ranging sections of the United States it is a well-recognized fact that if scab is to be detected in a flock examination must be made before or at the time of shearing. If the scabby sheep in these sections are shorn and turned out on the ranges, where the sunlight is very bright, the scabs dry up, drop off, and the lesions apparently heal. Evidently the infection is not destroyed, but remains dormant, as the disease will as a rule break out again under certain favorable conditions. After the wool

has grown sufficiently to shade the skin and the fleece becomes wet from rain, the disease usually becomes well marked.

The most important factor in spreading scab infection in the range country is the buck, which is a source of danger too often overlooked. It is the custom in many sections for owners of sheep to put their bucks in a "public buck herd." That is, a number of owners all turn their bucks into one herd and a sheep herder takes charge of this community buck herd and runs it on the open range until within a few weeks of the time when the bucks are to be turned into the ewe flocks. The herd is then split up, each owner taking his bucks home to be fed grain in preparation for the breeding season. These herds usually consist of from 1,200 to 1,500 bucks, representing a large number of owners. Should scab exist in any of the outfits at the time the herd is made up, the entire herd will become infected. Infection may find its way into the buck herd in a number of different ways, and once introduced the disease will be carried into all of the outfits represented, unless the herd is treated prior to disbandment. It is estimated that more than 90 per cent of the outbreaks of scab in the sheep-growing sections of the West can be traced directly to the public buck herds. All such herds should be dipped just prior to the time the animals are to be distributed to the various owners. This is one of the most important points in eradicating scab from the flocks on the open ranges where this custom prevails.

One or more attacks of the disease do not confer immunity, and a flock may become infected any number of times. After a flock has been properly treated and the disease cured by dipping, it may become reinfected, if exposed by contact with infected animals, bedded down on old infectious bed grounds and corrals, driven on trails or roads over which infected sheep have recently passed, turned on to infectious ranges, pastures, or yards where infected sheep have recently been, or in any other manner directly exposed to the infection. As a rule the visible symptoms of reinfection do not appear until after a lapse of 30 days from the date of the last dipping. If conditions are favorable and the sheep are thriving, a much longer period may elapse before they show visible symptoms of disease from exposure to infection after dipping. The dip that is left in the wool after dipping will often serve, for a limited period of time, as a preventive against reinfection. The length of this period of protection varies with the climatic conditions and the kind of dip used. If the sheep are exposed to frequent, heavy rains after dipping, much of the dip will be washed out of the fleece. A dip containing sulphur acts as the best preventive against reinfection. Under average conditions such a dip will probably afford protection for a period of from 30 to 60 days and, under favorable conditions, for a much longer time.

TREATMENT.

The only rational treatment for common scab consists in using some external application which will kill the parasites. Feeding sulphur and salt and various other preparations to sheep will not destroy the parasites and consequently will not effect a cure. Hand dressing, or "spot doctoring" as it is commonly called, consists in soaking the affected parts with a medicated solution of strength sufficient to kill the mites. This acts as a palliative and tends temporarily to check the disease, but will not effect a cure. The only conditions under which hand dressing can be advised are (1) when the disease develops in a few sheep of the flock during severe winter weather or just prior to lambing, in which event the infected sheep should be isolated from the flock and may be given a hand dressing to keep the disease in check until arrangements can be made for dipping the entire flock; (2) all sheep affected with hard scab should be separated from the flock just prior to dipping and the crusts or scabs broken up with a cob or stick and the spots soaked well with dip a little stronger than is used in the bath. It can not be too strongly emphasized that hand dressing, or spot doctoring, will not cure scab; in fact, in many cases it is responsible for spreading the disease, for the reason that the sheepman too often depends on this method to effect a cure. Meantime the disease is spreading throughout his flocks and the premises occupied are becoming infectious. Temporizing methods in dealing with sheep scab are expensive in the long run and should never be used or depended upon.

DIPPING SHEEP.

Dipping consists in immersing the sheep in a medicated solution that will kill the parasites, and is the only practical method known for eradicating the disease from the flock. The usual method is for the sheep to enter one end of a vat filled with dip, through which they swim, and leave the vat at the opposite end. The dip or solution should be used warm in order that it may penetrate the fleece and the hard scabs or crusts. Two dippings 10 to 14 days apart are necessary to effect a cure. The first dipping kills the live mites but does not destroy the eggs. Within 10 days after the first dipping the eggs on the skin at that time will have hatched out, but the new mites will not have reached maturity or laid eggs. The second dipping kills the new mites hatched subsequently to the first dipping.

As a basis of practice it may be stated that one dipping will not cure scab. Sheep in full fleece will retain more of the dip in the wool than freshly shorn sheep or lambs with short wool. If the active principle of the dip used is only slightly volatile and the

sheep have heavy fleeces, one dipping will sometimes effect a cure. The reason for this is that sufficient dip remains in the wool to kill the new crop of mites. One dipping, however, can not be depended upon to cure the disease, and it will fail to do so in the large majority of cases. It will certainly fail unless conditions are just right; consequently all scabby sheep should be given two dippings with an interval of 10 to 14 days between dippings. The entire flock should be dipped regardless of the number showing infection. To pick out the ones showing scab and dip no others will result in failure, as the disease will continue to develop in the undipped portion of the flock.

If the dipping is to be successful it is necessary to give close attention to the details and to see that the work is carefully and

FIG. 11.—Dipping sheep in cement vat, showing entrance.

thoroughly performed. Sheep should not be dipped immediately after shearing; a period of at least 10 days should elapse between shearing and dipping, in order that the shear cuts may heal. It is dangerous to dip sheep in some of the dipping preparations, especially lime-and-sulphur, if there are any fresh wounds on the animals; consequently dogs that bite the sheep should not be allowed in the dipping corrals. The chutes, pens, and dipping vat should be closely examined for nails, broken boards, or any object that may puncture or wound the skin of the sheep. Animals having fresh wounds when dipped in lime-and-sulphur usually develop a condition commonly known as "blood poisoning," and the mortality from this cause is high. It does not occur unless there are fresh wounds on the skin. After the wounds have granulated or healing is well

started there is little or no danger from this cause. Rough handling of the sheep at the time of dipping results in more harm and damage to the flock than is caused by the dip. When sheep are placed in the dipping vat by hand the men handling them should be instructed to do so carefully. They should not be allowed to catch the sheep by the ears; this is sometimes done and has resulted in breaking or bruising the skin, causing the heads to swell after dipping and resulting in considerable death loss.

Ewes and lambs should not be dipped together. The lambs should be "cut out" and dipped separately, and they need not be held in the swim so long as the older sheep. If the ewes and lambs are put into the vat at the same time, the danger of drowning some of the

FIG. 12.—Dipping sheep in wooden vat, showing exit.

latter is much greater than when they are dipped separately. It has been stated that the ewe recognizes her lamb more readily when they are dipped together; this, however, is probably not correct. A ewe recognizes her lamb by smell and not by sight, consequently after the flock has been dipped and the ewes and lambs have been turned in together there is considerable commotion for a time, as the ewes fail temporarily to recognize their offspring. However, the members of the flock will adjust matters for themselves, and, as a rule, practically every lamb will be recognized by a mother. It often happens that an undipped sheep will jump out of the pens and get in with those that have been dipped. This should be carefully guarded against and all such sheep dipped before the flock leaves the vat. By looking the dipped sheep over it is easy to

detect any undipped sheep that may have gotten in with the dipped ones.

Prior to bringing the sheep to the vat for dipping they should be watered and fed so as not to be thirsty or hungry at the time of dipping, although they will probably stand the effects of dipping better if not too full of feed and water at the time dipped. If they are watered and fed 3 to 6 hours before dipping, they will probably be in the best condition for the operation. When the weather is cold or stormy, dipping operations should be commenced early in the morning and finished for the day in time to give the last sheep dipped opportunity to dry off before night. During winter weather dipping for the day should be finished by noon so that the flock may have time to dry off and fill up with feed before night, as a sheep with a full stomach will withstand much cold and hardship. By observing these precautions sheep may be dipped with reasonable safety during cold weather.

Bucks should be dipped separately from ewes and lambs. They should not be driven fast and then put into the vat before resting and cooling off. As they succumb very easily in the vat it is necessary to give them careful attention. Hard scab on rams is difficult to cure and they should be held in the swim for 3 to 5 minutes. The hard scabs should be broken up by manipulation so that the dip may penetrate to every part. At the large vats the buck herds are usually dipped first, while the vat is full, so as to afford them more swimming room.

For dipping purposes soft water is better than hard; apparently some of the ready-prepared dips do not mix properly and are not effective with hard water. If hard or "alkali" water must be used it is improved and its effects on scab increased if it is softened or "cut" by adding lye or sal soda, but no more should be added than is required to cut the water. An excess of potash will tend to injure the wool and cause an irritation of the eyes.

DIRECTIONS FOR DIPPING.

The amount of dip in the bath should be sufficient to submerge the sheep completely. The depth of the dipping fluid in the vat should be from 40 to 48 inches, depending on the size of the sheep. The amount of fluid necessary to fill the vat to the required depth should be ascertained before it is prepared. Freshly shorn sheep and short-wooled lambs will carry out on an average from 1 to 2 quarts of dip, depending on the size of the sheep and the length and grade of wool, while full-fleeced, fine-wool sheep will carry out and retain in the fleece as much as 2 gallons. At late fall dipping the average medium-wool sheep will retain in the fleece about 1 gallon of dip. In estimating the amount of dip required, these facts should

be taken into consideration. After computing the amount of dip required to charge the vat, the average amount of dip which each sheep will carry out should be estimated; this should be multiplied by the number of sheep to be dipped and the product so obtained added to the amount required to fill the vat. If the vat and draining pens are watertight, so that no dip is lost through these sources, the total as given above should show the approximate number of gallons of dip required to complete the work.

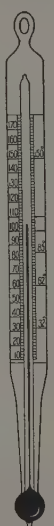

FIG. 13.—Floating dairy thermometer.

The temperature of the dip should not be a matter of guesswork, but should be ascertained accurately by using a thermometer. If it is too high the sheep may be injured, and if too low failure to cure will probably result. In field operations, when the dipping is supervised by inspectors, the temperature of the dip is maintained at 100° to 105° F. Practice has demonstrated that the lime-and-sulphur and nicotin dips should be used at these temperatures. The coal-tar-creosote and cresylic-acid dips should be used at slightly lower temperatures, the maximum for these being 95° F. For use in dipping small lots of farm sheep an ordinary dairy thermometer will answer the purpose. At the large vats where a great many sheep are to be dipped at least two thermometers should be provided as a precaution against breakage and delay. The thermometers used at dipping vats should be tested occasionally by comparison with another thermometer, so as to be sure that they are registering properly. (See figs. 13 and 14.)

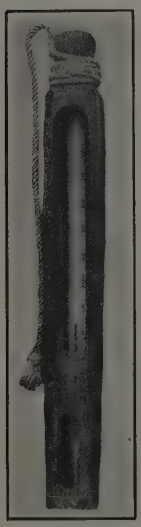

FIG. 14.—Thermometer used by Bureau of Animal Industry inspectors, in holder whittled from a block of wood.

After the vat is filled to the required capacity the contents should be well mixed by stirring, in order that the temperature may be uniform throughout. A good method of stirring the dip in large vats is to take a 5-gallon pail or dip container, punch holes near the top, insert a wire for a bail, allow the can to fill and partially sink, then drag it rapidly from one end of the vat to the other, and repeat the process until the temperature is uniform as shown by temperatures taken at several points in the vat. Stirring plungers are useful implements, and, as they are easily made, one or more should be provided at every vat. They are used in a manner similar to the

movement of the dasher of an old-fashioned hand churn. The plunger is pushed to the bottom of the vat and raised rapidly, the process being repeated as the operator moves slowly along the vat. The style shown in the cut is the one most commonly used. (See fig. 15.) The dip should be changed as soon as it becomes filthy, regardless of the number of sheep that may have been dipped in it. In emptying the vat the entire contents should be removed, including all sediment and foreign matter. After the liquid portion has been dipped out or drained off the sediment and dirt at the bottom should all be removed and the bottom cleaned by sweeping or scraping with a hoe or spade. After the lime-and-sulphur dip has been mixed to the proper strength for dipping and used in the vat, it should not be used again after it is 10 days old. This is a safe rule to follow with any of the sheep dips, as losses often occur from dipping in old or stale dips.

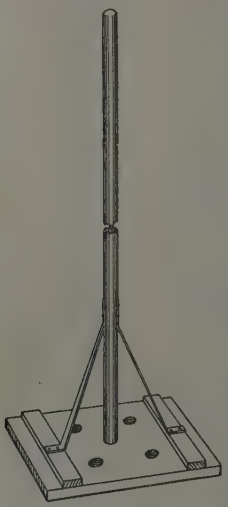

FIG. 15.—Stirring plunger for mixing liquids in the vat.

The time that infected sheep are held in the dip should in no case be less than 2 minutes; if the scab is not advanced, from 2 to 3 minutes in the vat is sufficient. But in well-advanced cases of hard scab on fine-wool sheep, especially bucks, better results are obtained if they are held in the vat from 3 to 5 minutes during the first dipping. If the hard scabs and crusts are broken up and soaked with dip before the sheep are dipped, it is not necessary to hold them in the vat longer than 2 minutes. In all cases in which the scab is advanced it is recommended that the hard scabs be broken and hand dressed with a solution of the dipping fluid so as to soak the affected parts well. In hand dressing such spots care should be taken not to cause the wound to bleed, as the blood will tend to protect the mites from the effect of the dip. After hand dressing such sheep allow at least 1 hour for the scabs to become soaked before placing the sheep in the vat. The time the sheep are in the vat should not be a matter of guesswork. A watch or a 2-minute sand glass should be used to make certain that the animals remain in the dip a sufficient length of time. Where a large vat is used and the sheep are running fairly well it is possible, after a little practice, to arrive at an average working rule as to how many sheep are to pass through the holding gate each time it is raised.

Drowning sheep in the vat can be avoided by proper care. Men with dipping forks should be stationed along the vat on both sides to attend to the sheep and prevent accidents. When the vat becomes filled with sheep their progress is retarded and the tendency is for each sheep to place its front feet on the back of the sheep in front and thus raise its forequarters out of the dip. The men along the vat should prevent this by keeping the sheep properly arranged in the vat. The dipping forks should be used to keep all of the sheep's body submerged but its head while it is passing through the vat; this can be done by placing the dipping fork over the shoulders of the sheep and gently but firmly pushing it under the dip. The animal will raise its nose so that the neck and part of the head can be submerged without danger of strangling. Old ewes that have been dipped a number of times are sometimes difficult to handle, both in the chutes and in the dip. They will often lie on their sides in the vat, bracing themselves with their feet against one side and their backs against the other. When pushed under they will make efforts to regain this position and may strangle. Sheep that are affected by eating loco weed often drown in the vat unless they are piloted through. When strangling occurs the sheep should be taken from the vat. If it does not get upon its feet, pull the tongue forward, dash cold water over the head and body, and, if necessary, induce artificial respiration. When it has acquired sufficient strength, and if it has not been in the dip long enough, the animal should be returned to the pens and piloted through the vat again.

FIG. 16.—Two styles of dipping forks.

DIPPING FORKS.

In using large vats dipping forks are necessary for the efficient handling of the sheep and should be provided as part of the equipment at every plant. There are a number of different styles made, but the two shown in the illustration are the ones commonly used. The one with both hooks turned upward seems to have the preference for the reason that when it is in use either side may be hooked under the neck of the sheep for raising the head in case of strangling. (See fig. 16.) The handles should be strong and from 5 to 6 feet long. The hooks should be made of half-inch round iron and firmly held in the handle by an iron ferrule. These forks can be bought ready-made or may be made by any blacksmith.

EXPENSE OF DIPPING.

The cost of dipping naturally varies in different sections; it also varies in the same section, depending on the number of sheep to be dipped, the location relative to the necessary supplies, and the facilities available for the work. The labor, fuel, and cost of the materials are the three principal items of expense. In the sheep-growing sections of the West the average cost of dipping sheep varies from 2 to 3½ cents per head for each dipping.

CHOOSING A DIP.

There are many dipping preparations on the market. The farmer or sheepman should not be deceived by exaggerated statements made by manufacturers. He should know the nature of the dip he is using and its effects upon the sheep when used in the kind of water which he has available. If a ready-made dip is to be used, one should be selected that will kill the parasites and not cause undue injury to the sheep. Almost any of the better-known ready-prepared dips will prove satisfactory if used according to directions and with pure water. If the dipping plant is not supplied with pure, soft water, a dip should be selected that will work well in the kind of water available. Lime-and-sulphur dip mixes properly and is effective with almost any kind of water. The coal-tar-creosote and cresylic-acid dips apparently do not mix uniformly with some of the hard waters, and they should not be used with such waters.

The dips on the market to-day can be divided into five general groups—those containing arsenic, the cresylic-acid group, coal-tar-creosote dips, nicotin, and lime-and-sulphur. Of these the Bureau of Animal Industry recognizes only two groups for the official dipping of sheep for scabies, namely, lime-and-sulphur and nicotin-and-sulphur.

It has been determined from actual experience over a large field that dips deteriorate by use; that is, after a number of sheep have passed through the vat the active principle of the dip falls below the standard required for effective work. In order to overcome this difficulty and keep the dip up to standard while being used, chemical testing outfits have been designed that can be used at the vat to determine the percentage of the active principle in the dip at any time.[1] In this way the strength can be kept up to the required standard. Before approving a dip for use in the official dipping of sheep, one of the requirements of the Bureau of Animal Industry is that there shall be a practical field test for such dip. Of the five general classes of sheep dips named above, excluding arsenical

[1] See U. S. Department of Agriculture Bulletin 163, A Field Test for Lime-and-Sulphur Dipping Baths, by Robert M. Chapin. Washington, 1915.

dips for other reasons, the lime-and-sulphur and nicotin-and-sulphur are the only ones for which at present we possess a practical field test.

Whatever dip is selected, the sheep grower should not forget the fact that there are two ways of using it. One way is to use it according to directions given; the other way is to attempt to economize time, labor, or money by using it in weaker proportions than advised and by hurrying the sheep through the swim or failing to dip all the sheep in the flock. If the former method is adopted with any of the established dips the treatment should result in a cure. If the latter method is followed failure to effect a permanent cure will result regardless of what kind of dip is used. It is a loss of time and money to dip sheep unless the work is done properly. Desired results can be accomplished only by performing every part of the work thoroughly and in accordance with approved methods.

PREPARATION OF DIPS.

If a ready-made dip is selected it should be prepared and used in accordance with the printed instructions on the label.

THE LIME-AND-SULPHUR DIP.

The lime-and-sulphur dip is made in the proportion of 8 pounds of unslaked lime (or 11 pounds of commercial hydrated lime, not air-slaked) and 24 pounds of flowers of sulphur or sulphur flour to 100 gallons of water. Place the lime in a watertight, shallow box and add sufficient water to form a thin paste. Sift the sulphur into this and mix well until a paste of about the consistency of mortar is formed, adding water as required. Place this lime-and-sulphur paste into 30 gallons of boiling water and boil for at least 2 hours, adding water from time to time to maintain the quantity at 30 gallons, or in that proportion. During the boiling process the mixture in the boiling tank should be stirred well to prevent the paste from settling and caking on the bottom of the tank; the boiling process should be continued until all sulphur disappears from the surface. A large mortar hoe is a good implement with which to stir the boiling mixture. The lime and sulphur should both be weighed; do not trust to measuring them in a pail or guessing at the weight. It sometimes happens that the sulphur is not all "cut" or dissolved; this is especially true if the lime is not of first-class quality. Those who have had considerable experience in the preparation of lime-and-sulphur dip sometimes add small quantities of extra lime if during the cooking they see that the sulphur is not being "cut" properly. It is advisable, however, for the beginner to hold strictly to the formula laid down, as an excess of lime in the dip will tend to

injure the sheep and the wool. After the mixture has been boiled for 2 hours the liquid should be of a chocolate or dark-amber color.

The contents of the boiling tank should be drawn off or dipped out and placed in the settling tank and allowed to stand until all sediment has settled to the bottom and the liquid is clear. The use of some sort of settling tank provided with a bunghole is an absolute necessity, unless the boiler is so arranged that it may be used for both boiling and settling. An ordinary, water-tight barrel will answer very well for a settling tank at small vats. All settling tanks of every nature should have an outlet at least 4 inches from the bottom in order that the clear liquid may be drawn off without its becoming mixed with any of the sediment. (See fig. 17.) Drawing off the liquid as above indicated has an advantage over dipping it out, for the reason that in the latter case the liquid is stirred more or less and mixed with the sediment. The prime object is to get the clear liquid without any sediment; the latter should under no circumstances be allowed in the dipping vat, as it will injure the wool and the eyes of the sheep.

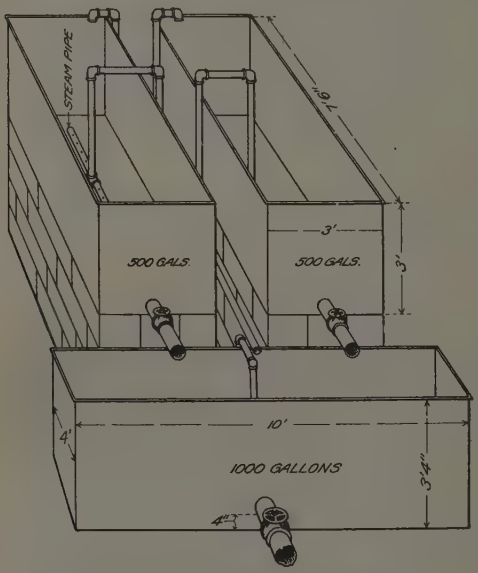

FIG. 17.—Cooking and settling tanks.

When fully settled draw off the clear liquid into the dipping vat and add warm water sufficient to make a total of 100 gallons of dip. When mixed and cooked as above specified the concentrate is $3\frac{1}{3}$ times the strength required for the dip in the vat, so that to every 30 gallons of such concentrate 70 gallons of warm water should be added to make a dip of the required strength.

In preparing lime-and-sulphur dip in large quantities several hundred gallons of concentrate are often made at one time in a single large cooking tank. The amount made at one boiling is limited only by the facilities at hand. If the boiling tank is of sufficient capacity

enough lime-and-sulphur paste should be cooked at one time to dip the flock. The quantity of mixture in the cooking tank may be varied at will, but the proportions of the various ingredients should not be altered.

THE NICOTIN-AND-SULPHUR DIP.

The nicotin-and-sulphur dip is made with sufficient nicotin solution and flowers of sulphur to give a mixture containing not less than five one-hundredths of 1 per cent (0.05 per cent) nicotin and 2 per cent sulphur. Sufficient nicotin for 96 gallons (about 800 pounds) of dip would therefore be furnished by 1 pound of a 40 per cent solution of nicotin. The formula for this dip would be: Nicotin, four-tenths of a pound; flowers of sulphur, 16 pounds; water 96 gallons.

To calculate how much nicotin solution should be used for 96 gallons of water, divide the quantity of nicotin required in the dip by the proportion of nicotin in the product. For example, suppose the nicotin solution contains 25 per cent nicotin, we have $0.40 \div 0.25 = 1.6$. Therefore in this case it would require 1.6 pounds of nicotin solution for the 96 gallons of dip. No preparation the strength of which is not given on the outside of the package should be used.

In preparing these dips the nicotin solution and sulphur should be mixed together with water before adding them to the water in the dipping vat. The dip should on no account be heated above 110° F. after the nicotin solution is added, as heat is liable to evaporate the nicotin and weaken the dip.

DETERMINING CAPACITIES.

One of the first steps in opening a dipping plant is to ascertain the capacity of the vat and the various tanks. The capacity of the vat is usually obtained in the following manner: In 1 gallon there are 231 cubic inches; multiply the average length by the average width in inches, then the product by the depth; this will give approximately the number of cubic inches of space to be filled with dip. Divide this by 231 and the result will be approximately the number of gallons of dip required to charge the vat.

To obtain the average length, add the length at the bottom to the length at the top (that is, at the line to which the vat is to be filled) and divide this sum by 2. Obtain the average width in the same manner. The depth should be taken at the center of the vat, and should be from bottom to dip line only and not to the top of vat. Likewise in determining the length and width measure only the space to be filled with liquid and not above that line. The capacities of

the various tanks are obtained by a like process. Gauges or rods should be prepared and marked to show the number of gallons at various depths in the vat and tanks.

INJURY FROM DIPPING.

Dipping often results in a slight setback to the sheep. There may be a temporary shrinkage in weight, constitutional disturbances, or both. Usually there are various factors operating to produce these conditions. They may occur with any of the standard dips, but should not always be attributed to the effects of the dip alone. The age and physical condition of the sheep, the method of handling the flock at the vat as well as before and after dipping, the character of the water used, the method of preparing the dip, and various other factors should be given consideration before placing the blame on the dip. Young animals in a thriving condition recuperate very rapidly from any temporary ill effects; while old, weak, or emaciated animals succumb very readily and regain lost weight slowly. Injury caused by dipping is more liable to result from improper methods of dipping and handling than from the direct effects of the dip. Rough handling of the sheep in the corrals and legging pens, dipping the flock immediately after a long, hard drive before they have rested and cooled off, dipping late in the afternoon when the nights are cold, keeping the sheep without feed and water for long periods before and after dipping, using dogs in the corral, and fighting stubborn sheep to get them into the chutes, are some of the contributing causes of injury.

Much of the water in the range country carries various amounts of mineral salts, and is commonly known as "alkali" water. Some of the dips do not seem to mix properly with many of these waters and when they are used a separation apparently occurs, so that part of the sheep get too much of the active principle of the dip with resultant injury or death, while others get less than is required to kill the parasites. The lime-and-sulphur dip is about the only one that is safe to use with very impure water, although the nicotin dips mix well and are effective with most waters. Any of the dips if used too strong will injure the sheep.

In practical operations it is an established fact that lime-and-sulphur and possibly other dips are liable to cause serious injury to sheep if there are any puncture wounds. A condition commonly known as "blood poisoning" is produced, probably caused by micro-organisms entering the tissues and the action of the dip searing or sealing the wound so that the air is excluded and drainage stopped. Pure lime-and-sulphur solution will not injure a sterile wound. The dip does not directly cause the "blood poisoning," but acts only as a contributing cause and can be avoided by allowing wounds to

granulate or heal before dipping. It may be stated that experience has demonstrated that when sheep are properly dipped in accordance with the rules of best practice in any of the approved dips, the loss or damage is practically nil.

The question often arises as to the proper age at which lambs should be dipped to get the best results and cause the least damage. When the average lamb in a flock is 1 month old it is perfectly safe to dip the flock provided the lambs are dodged out and dipped separately. Any slight shrinkage caused at this time will be quickly regained and the lambs will grow and thrive much more rapidly after being freed of the irritation caused by the scab mites. If the work is properly done and the sheep carefully handled, pregnant ewes may with safety be dipped any time up to within one month of lambing.

There has been much controversy and argument concerning the effects that various dips have on the wool, and many experiments have been conducted and observations made over wide areas. The general opinion among the unprejudiced seems to be that the various well-known dips properly prepared and used injure the wool very little, if any. It is necessary to eradicate scab to make wool growing profitable or even possible. Lime-and-sulphur and nicotin-and-sulphur are among the dips that have proved effective and have been generally used as scab eradicators, both in this and in other sheep-growing countries. It is therefore considered that any slight damage they may cause to the wool is more than equaled by their good effects in eradicating scab.

CLEANING AND DISINFECTING PREMISES.

All premises occupied by scabby sheep will become infectious. Tags of wool which often carry mites and eggs are constantly being pulled out. Old bed grounds, corrals, sheds, or any place where infected sheep have been confined or held until the manure has accumulated are especially dangerous. It is probable that bright sunlight kills the mites, but if they can get under manure or anything that affords shade, moisture, and protection the infection may remain for as long as one year. Sheep free from infection should not be allowed on infectious premises. Old bed grounds, corrals, and other places of close confinement should be avoided unless they have been cleaned and disinfected. Ranges, pastures, trails, and grounds around watering places exposed to the sunlight probably do not, as a rule, remain infectious longer than 30 to 60 days. It is well, however, to avoid places over which infected sheep have passed. Such places, as well as old bed grounds on the range, can not be disinfected, or at least it is not practicable to do so, and therefore they

should be avoided. The average sheep herder seems to have a desire to use old bed grounds, and unless means are taken by the owner to prevent it he will continue to bed the flock on old infectious bed grounds after they have been dipped, thus constantly exposing the sheep to reinfection. Corrals, pens, chutes, and sheds can be disinfected, and they should either be cleaned and disinfected or destroyed if they have contained infected sheep. Remove all manure and litter down to a smooth, hard surface and burn the manure and litter so removed or spread on a field and plow under. Spray the entire surface of fences, grounds, and floors, as well as the walls of sheds or buildings, with a disinfectant, such as a coal-tar-creosote or cresylic-acid solution mixed to double the strength recommended for dipping. The work should be well done, otherwise it will not prove successful. All brush corrals on a range where scabby sheep have been should be burned. Corrals of a more permanent nature may be moved to new locations, but the lumber should be disinfected by spraying or passing through the blaze of an open fire before being used.

DIPPING PLANTS.

There are numerous kinds of dipping plants in use, the size and style varying according to the conditions which are to be met and the individual taste of the owner. The farmer who has but a small flock to dip can use a small portable vat as shown in figure 18, turning a part of his barnyard or sheds into catch pens for temporary use, but if he is in the sheep business to stay he will find it advisable to make arrangements of a more permanent nature. Portable galvanized-iron dipping vats, called "hog vats," can be purchased ready-made and will answer the purpose very well for dipping small lots of farm sheep. A dipping bag is sometimes used for dipping when there are only a few sheep to be dipped at different points in a given section. For this purpose it has the advantage of being easily transported. It is made of heavy canvas, known in the trade as No. 40, and is constructed as follows: Two strips of canvas 8 feet long and 26 inches wide are sewed together to form a bag 48 inches deep and 94 inches in circumference. Seams are triple-sewed, top and corners reinforced with leather strips riveted on. (See fig. 19.) Iron rings held by leather ears are riveted to the upper part of the bag as shown in the cut. The bag is filled with dip, the

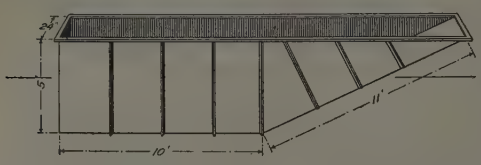

FIG. 18.—Portable galvanized-iron sheep dipping vat.

sheep's feet tied and the animal is set down in the bag and held the required length of time.

Heating tanks or boilers are necessary, the size varying with the number of sheep to be dipped. An ordinary iron caldron or kettle will answer the purpose for a small number of sheep. A rectangular, galvanized-iron tank with large heating surface is preferable. Such a tank is set on two parallel walls, the walls forming the sides, and the bottom of the tank forming the top of the fire box. An opening large enough for the escape of the smoke should be provided at the end opposite that at which the fire is fed.

When large flocks are to be dipped it is necessary to provide proper facilities for the work and a permanent dipping plant is the only practical solution.

FIG. 19.—Dipping bag, made of No. 40 canvas.

SELECTING A LOCATION.

In selecting a location for a dipping plant the fact that sheep work better upgrade should be given consideration, and if possible the ground used for the receiving corrals and chute should slope up to the end of the vat. The vat itself should be on level ground and preferably extend north and south, with the entrance at the south and the exit at the north, as it has been observed that sheep work better when not facing the sun. If the ground selected has good natural drainage it is a point in favor of the location.

CORRALS AND CHUTES.

One of the important points in constructing a dipping plant is the arrangement of the corrals. Here is where much damage is often caused to the sheep and later attributed to the preparation in which they were dipped. The receiving corral into which the sheep are driven preparatory to dipping, as well as the holding corral into which they go from the draining pens, should each be large enough to hold a full band of sheep, or about 3,000 head. The

receiving corral should be so constructed that there may be the least practicable number of corners or places in which the sheep may become jammed or "piled up."

The nature of the sheep is such that in an effort to get out it will try to go back to the place where it entered the corral; therefore, if the entrance gate is near the vat the herd will tend to crowd toward the vat and thus save considerable work in getting them into the chute or catch pen. The corrals and chutes may be so arranged that a combination legging pen and running chute is provided. Sheep will usually work well in a chute the first time they are dipped at a vat, but with old ewes that have been dipped several times at the same vat it is often necessary to put them into the vat by hand. The location and arrangement of the chutes are sometimes changed from year to year so the sheep may not recognize them so readily. The running chute should be curved to obstruct the view, and the side on which the men work should be tight boarded. The usual height for the sides of the chute is 40 inches. Sheep work well uphill but not down an incline; the chutes and alleys, therefore, should be upgrade to the vat. If necessary elevate the running chute so that it slants upward to the slide board. A small pen should be provided near the entrance to the vat and so arranged that the sheep may see it. This pen, known as a "decoy pen," is filled with sheep to induce the other members of the flock to work toward the vat more readily in their efforts to join those in the pen. The size and arrangement of the corrals will necessarily vary with the topography of the location and the individual ideas or tastes of the owner.

DRAINING PENS.

When a sheep emerges from the vat it carries out a large quantity of dip in the fleece. The major portion of this dip drains out of the fleece very rapidly and it is desirable that it be saved and returned to the vat. Draining pens with water-tight floors sloping toward the vat should therefore be provided. The size will depend upon the size of the plant and the number of sheep to be dipped. The relative size shown in the plans illustrated in figures 20 and 21, may be followed, increasing or decreasing the size of the pens to correspond to the length of the vat. There should be two draining pens, each having an opening into the holding corral. They may be made of lumber or cement and should have catch basins or screening and settling wells into which the dip drains so as to prevent manure and foreign matter from being carried into the vat. Drawings of screening and settling wells will be found in the plan of the cement dipping plant in this bulletin. (See fig. 21.) In constructing draining pens of cement it is advisable to build the outer walls in the same manner

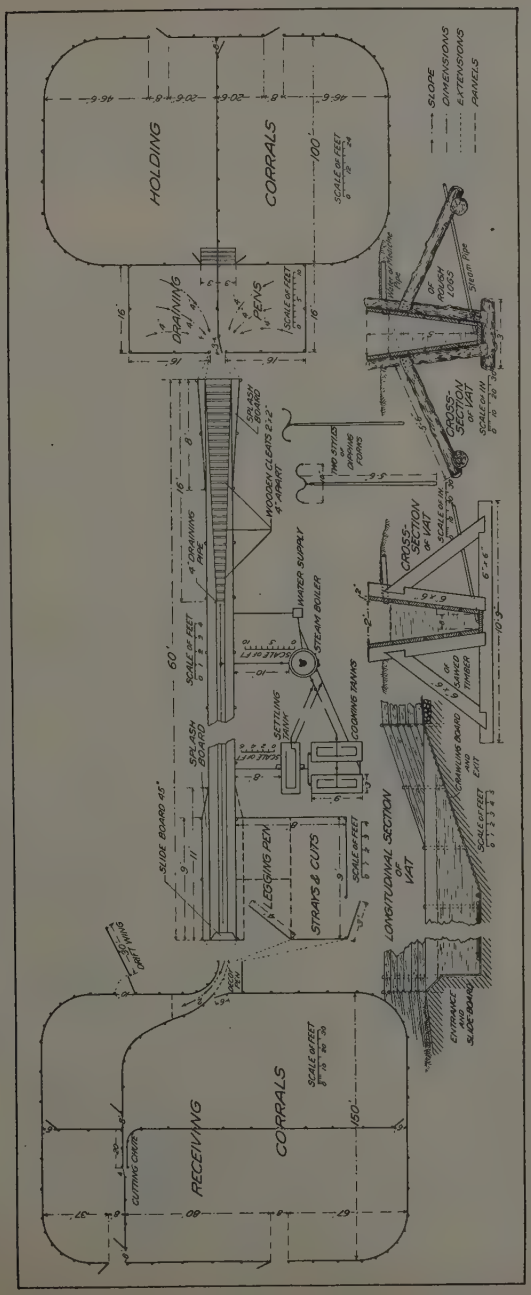

FIG. 20.—Plan of wooden dipping plant.

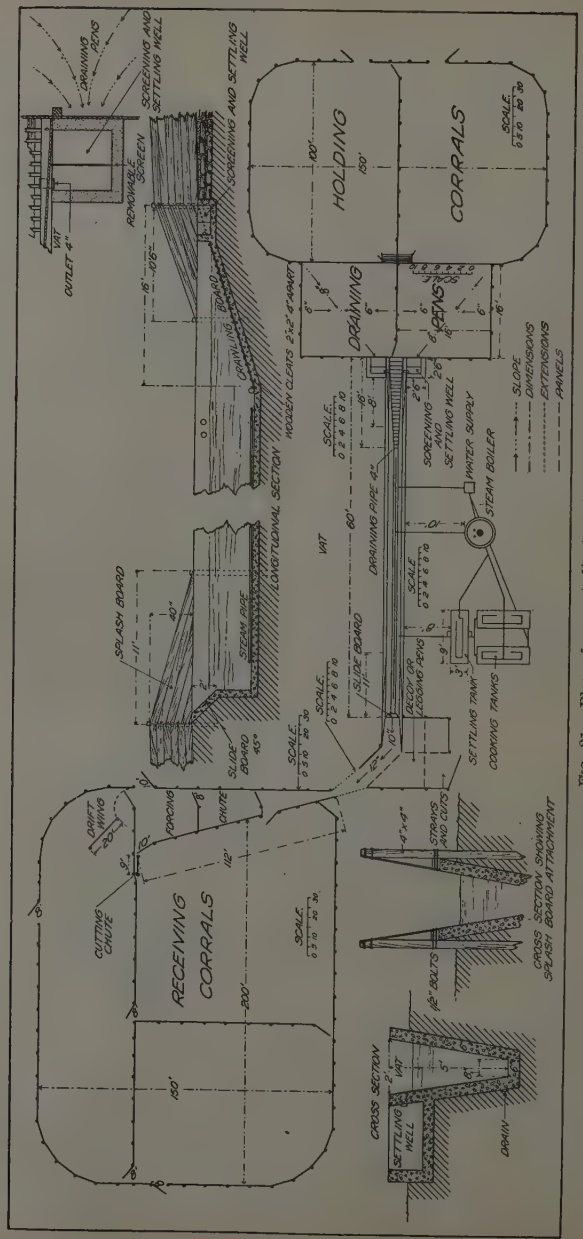

FIG. 21.—Plan of cement dipping plant.

as the foundations for a house, except that they are to be 6 inches thick. The space inside these walls is then filled with gravel to the required height and the floor laid on it. Cement floors should have rough surfaces to prevent slipping. A coat of "pebble dash" over the cement floors will afford a suitable surface for the sheep to stand on. The floors of draining pens should slope so that the dip will drain away rapidly and not collect in pools from which the animals may drink.

VATS.

The dipping vat may be constructed of either lumber or cement, the cement vat being preferable. The length of the vat may vary from 30 to 100 feet, depending on the number of sheep to be dipped. Public dipping vats, where from 50,000 to 100,000 sheep are dipped each season, should be 100 feet long. The depth should be 5 feet, width at bottom 8 inches and at top 2 feet. Sheep vats are usually so constructed that the top is flush with the top of the ground and there should be no cross pieces to interfere with free action of the sheep or of the men working along the vat. As a matter of individual taste, however, the top of the vat may extend from 9 to 18 inches above the ground. Those of the latter kind afford a better opportunity to handle the sheep and can be operated with less effort. If it is desired that the top of the vat shall be flush with the ground, it should first be built at least 4 inches above the natural surface of the ground and then dirt or gravel may be filled in, thus securing proper drainage along the sides.

Whenever it is possible to do so the gravity method of draining the old dip out of the vat should be adopted, as otherwise it is necessary to pump or dip it out each time the vat is cleaned. The end of the vat having the drain should be slightly lower than the other end so that all the liquid will drain off. The slide board into the vat should be set at an angle of 45 degrees and extend from the floor of the chute to at least 4 inches below the dip line; it should be made of or covered with a smooth-surfaced material, such as planed lumber or sheet metal. The end extending into the dip should be flush with the vertical end of the vat. A space between the slide board and the end of the vat, if large enough for a lamb to lodge in, is a dangerous arrangement. The runway leading out of the vat should not be too steep. The length varies from 8 to 16 feet, the latter being preferable in large vats.

HEATING FACILITIES.

When lime-and-sulphur dip is used it is necessary to provide cooking tanks. The cooking may be done by steam or in open boilers

having a fire box under each. All large plants should have steam boilers of not less than 25 horsepower. The live steam can be piped into the dipping vat and used for maintaining the temperature of the dip and also into the cooking and heating tanks for boiling the dip or heating water. The steam pipes should extend along the floor of the vat at least two-thirds of the length and be provided with openings for the escape of the steam into the dip. The supply pipe from the settling tank should enter the vat above the dip line in order that any leak may easily be detected.

CARE OF PLANT WHEN NOT IN USE.

A dipping plant that does not receive proper care when not in use deteriorates very rapidly. The pressure of the ground against the sides of the vat tends to cause them to bulge inward; this tendency may be counteracted to some extent by keeping the vat full of liquid. Wooden vats which are allowed to stand empty, dry out, and the lumber shrinks so that the vat will leak when refilled. At the close of dipping operations the vat should be left full of liquid and water added from time to time to restore that lost by evaporation.

A week or 10 days prior to beginning dipping operations the entire plant should be overhauled and put in good condition. Before charging a new vat or one which has stood empty for some time, it should be filled with water to ascertain whether it leaks.

CONSTRUCTION OF DIPPING PLANTS.

Plans for the construction of cement and wooden sheep dipping plants are shown in figures 20 and 21. They are not drawn to a uniform scale, consequently, in studying the drawings the scale of each part should be noted. The plants as shown have no superfluous equipment and the arrangements are as simple as is consistent with efficiency. The size of the plant can be increased or decreased as desired. A different corral, chute, and legging pen arrangement are shown with each vat. All parts are interchangeable and are suitable for use with either vat. Cross fences as desired can be added to the corrals. Cutting chutes are shown in both plans, as every large dipping plant should have such a chute equipped with a dodge gate so the lambs may be cut out and dipped separately.

If permanent pipes are used for conducting water and dip to the vat they should be so laid as not to act as an obstacle to the men working along the vat. There should be no obstructions to the path along both sides of the vat. The pipes can be placed under the ground or a portable V-shaped trough can be used for conducting liquids into the vat and laid aside when not in use.

THE WOODEN VAT.

As shown in the plans for the wooden vat, one side of the running chute is made of portable panels so they may be shifted and the space converted into a legging pen. Two styles of framing are shown. In the cedar-growing sections the cedar-post frames are preferable because they do not decay rapidly, while the sawed white-pine timbers do. Where hardwood is used instead of white pine the frame timbers need not be so heavy; 4 by 4 inches is heavy enough for framing in hardwood. The frames are set from 2½ to 4 feet apart, depending on the character of the soil and the material used; 2½ feet apart is a safe rule, as the closer the frames are to each other the less tendency there is for the sides of the vat to bulge in between the frames. Two-inch tongued-and-grooved planks should be used in making the vat, and they should be beveled so all joints and seams may be properly calked with oakum or similar material.

THE CEMENT VAT.

In the plan for the cement plant the corrals and chute are very conveniently arranged. The portable panels can be shifted to form either a running chute or a legging pen. The settling and screening wells shown can also be constructed as a part of any vat by changing the slope of the draining pens so the dip will run into the wells instead of down the runway. In making the forms for a draining well, the groove into which the removable screen is to sit should be provided for, as well as the 4-inch opening into the vat.

The trench for a cement vat should be excavated so the inside dimensions correspond with the outside dimensions of the vat when completed. If the sides of the trench are smooth and reasonably firm, they can be used as the outer wall of the form, but in all cases where the vat is extended above the surface of the ground it is necessary to build forms extending from the surface of the ground to the top of the vat. If the soil is sandy, it will be necessary to build outer forms, in which case the trench should be wide enough to allow for these forms. The drain and other pipes shown in the drawing should be placed in the form and should all be threaded and capped so proper connections may be made. Three pairs of ½-inch bolts should be embedded in the concrete of the incline for attaching the false floor or runway. This floor is made of 1 by 6 inch boards laid lengthwise with cross cleats, as shown in drawings. Two pairs of bolts also should be embedded for attaching the slide board. Steam pipes should not be molded into the concrete walls, as the vibration of the pipes will crack the cement. They should pass over the top of the vat and down the side in a groove formed

in the wall, so they will not come in contact with the sheep or cause annoyance to the men working along the vat.

The walls should be made 6 inches thick, constructed of concrete mixed in the proportion of 1 part of cement, 2 parts sand, and 4 parts broken stone or gravel. This mixture is slushed into forms properly set, and when it approaches dryness the forms are removed and the inside surface of the vat coated with pure cement mixed to about the consistency of cream and applied with a brush. It is important that this coating be well brushed in so as to fill all cavities and form a smooth surface. Finishing coats of sand and cement applied with a trowel after the forms have been removed are liable to crack and scale off.

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